

SCIENCE

FRIDAY, JULY 8, 1887.

IN THE LEADING civilized countries in which a decimal system of weights and measures is not in vogue, there are considerable bodies of men urging the adoption of at least a decimal coinage. From time to time attacks are made on the time-honored and inconvenient pounds-shillings-and-pence system in which English trade is carried on, but thus far conservatism has proven too mighty even for convenience. It is nevertheless true, that, each time the agitation for a decimal system is begun in Great Britain, it obtains larger support than before, though the opposition to it loses nothing in vehemence. Within a few weeks an influential deputation has waited on the chancellor of the exchequer to urge his advocacy of a decimal coinage. The deputation represented sixty-eight provincial chambers of commerce, all of which, out of a total of sixty-nine, have passed resolutions in favor of a change to a decimal system. The deputation urged the change on five grounds: first, because every foreign country in the world possessed a decimal currency, and some of the British possessions (Canada, Ceylon, and Mauritius); second, because no country which had once adopted the decimal system of currency had retraced its step; third, because the mathematical education in the schools would be simplified by the use of the decimal system for measuring values, and consequently the period necessary for education in the elementary schools would be shortened; fourth, because experience proved that in business-houses in decimal-using countries considerable time was saved in calculations both for home and foreign business, while transactions between countries using the decimal system were rendered uniform, and an economy of labor therefore resulted; and, fifth, because the British currency might be placed upon a decimal basis with a minimum of change by decimalizing the pound sterling. It is proposed to decimalize the pound sterling by making it equal to 1,000 mills, the mill to be the unit of the system. Then the half-sovereign would equal 500 mills; the crown, 250 mills; the double florin, 200 mills; the half-crown, 125 mills; the florin, 100 mills; the shilling, 50 mills; and the sixpence, 25 mills. Three new coins would be necessary, — a dime, equal to ten mills; a half-dime; and a new farthing, equal to one mill. Various speakers enlarged on these arguments. Mr. Goschen, in reply, acknowledged the importance of the subject and the authority of the delegation, but he could give no promise of government action, because a reform of so far-reaching a nature depends for its success on a practical unanimity of popular sentiment; and that, Mr. Goschen thought, is far from having been reached at present. He closed by encouraging the deputation to go on with their propaganda, and endeavor to unite public sentiment in favor of the change. If that were done, he felt sure the necessary legislation would follow.

IT IS THE PRIVILEGE of the philosopher, at least of such a one as bases his right to that title on the practical comprehensiveness of the study of his choice, to have an important word on those general problems of civilization most intimately connected with human development. And it is the privilege of our age to emphasize the truth that every intellectual worker is to a greater or less extent a philosopher in his own domain. It is not a coincidence, but a deeply significant fact, that the 'new education,' the 'new political economy,' the 'new psychology,' the 'new biology,' and the rest, are all claiming attention at the same time. It is the expression of the consciousness of the changed conditions of modern life. A most

alarming symptom of this change is the increasing frequency of mental 'breakdown,' caused by a failure to adapt one's self to the changed environment. For the use of the mental powers, we now substitute their abuse. The business-man is worried into insanity, the student hurried into unhealthy precocity, and the woman forced into an imprudent competition with man. One of the earliest cries of warning to the most restless of all nations, the Americans, was raised by Dr. S. Weir Mitchell, in a paper entitled 'Wear and Tear,' which has just reached a fifth edition as a separate publication. In the period since its first appearance, this sermon has been preached by educators, political economists, and psychologists, as well as by the family physician, and to some extent has been listened to. Practical men are so apt to think that the studies of the theoretical scientists are more or less the pursuit of useless hobbies, that the opportunity of so glaringly showing the essential importance to them of theoretical science should not be neglected. To be able to express physiologically and psychologically such doctrines as are suggested by the practical experience of thoughtful men, endows these principles with the authority of natural laws, and sanctions their introduction into the elementary education of the next generation. It makes science out of opinion. The cause which Dr. Mitchell pleads under the above terse heading is well known to-day. It is simply the problem of obtaining a maximum of work with a minimum of overwork; a brisk and healthy wear without a rushing and wasteful tear. And it is because this problem is so largely the problem of a rational education founded upon a scientific psychology, that it merits notice in this column. With the successful solution of this problem, — and all this applies with increased force to our country, — the new education, the new political economy, the new psychology, and the new biology will all have succeeded together.

THE INCREASE OF STATE INTERFERENCE IN THE UNITED STATES. — II.

AS TO THE States of Rhode Island and Connecticut, our information is fairly full and accurate, though showing a curiously divergent condition of things in two adjoining States. The secretary of state for Rhode Island finds, as the result of nearly twenty years' experience in connection with the legislation of the State, the tendency has rather been away from than toward interference with personal concerns. Numerous matters of that nature which formerly occupied the attention of the Assembly have now ceased to have attention, the jurisdiction of the courts having been enlarged so as to cover such matters. The Legislature has further established a joint rule to the effect that "neither House shall entertain any petition the subject of which is within the jurisdiction of any court in the State." Rhode Island, owing to a peculiar constitutional provision, has no general act of incorporation, and every charter is a special act of the Legislature. In granting these charters, much of the time of the Assembly is occupied.

From Connecticut Professors Hadley and Farnam of Yale agree in pointing out the Sunday traffic (railroad) law, the law limiting the hours of employment for women in stores and factories, the law prohibiting child-labor under thirteen years of age, the law making weekly payments compulsory, and the laws providing for the inspection of certain classes of business, as the latest particulars in which State interference is being manifested. Mr. A. Hills of Bridgeport finds that Connecticut legislation is showing "an increasing tendency to interfere between employers and employed, and generally to regulate matters which individuals ought to be left to arrange between themselves." Mr. Morris F. Tyler is of similar opinion. He writes, "It may be said that legislation in Connecticut shows that in almost all the relations of life the meddle-

some legislator has thought of touching. We do not regulate the price that a man shall pay for his food and clothing, but we do say what kind of food and clothing can be sold to him, and under what conditions. In looking over the statutes of the session just closed, I see that it will no longer be safe for a man to send his children to a private school unless that school complies with some of the technical regulations of the State Board of Education in the matter of returns to their secretary; that a man cannot sell the securities of foreign trust and investment companies in this State unless those companies have submitted to certain examinations by our bank commissioners. Butter and molasses are under the protecting care of the dairy commissioner. Nobody can negotiate the insurance of his neighbor without a license to do so from the insurance commissioner. A man cannot travel on a railroad-train on Sunday, and have the benefit of his commutation or mileage ticket. If, in case of illness in my family, I find there is no brandy in the house, and it is wanted at once, it is illegal for my grocer to give it to my boy if I send him for it in a hurry. If I run a factory, it must be run as the newly appointed inspector of factories says is right, and not as the business may compel me."

The data from New York State which has reached us, while plentiful, is not very specific. The large majority of our correspondents in that State coincide in stating that State interference is on the increase. Assemblyman Ernest H. Crosby of New York City writes that interference has lately been shown in the appointment of such officials as railroad commissioners, factory inspectors, commissioners of arbitration, and so forth, and in acts regulating the price of gas, limiting the hours of labor on street-railways, etc. Mr. Herbert L. Osgood of Brooklyn refers to the Mechanics' Lien Act of 1885 as an interference with the freedom of contract. He mentions also an act compelling employers to erect proper scaffoldings for those at work upon buildings, an act regulating the height of dwellings in New York City, acts relating to the manufacture and sale of oleomargarine, the sale of butter, the slaughter of cattle, etc. The State expends about twenty-eight thousand dollars a year in subsidizing agricultural societies.

With respect to State interference in New Jersey, we are in possession of extremely full returns, for the most valuable portions of which we are under obligations to Mr. William I. Lewis of Paterson. Mr. Lewis finds as the result of a careful examination of the legislation since 1878, — to and including the session of 1886, — that about two-sevenths of the laws show a marked tendency toward interference with personal affairs, and about one-seventh additional show a slight tendency in that direction. In the period mentioned above, 2,016 laws have been enacted, and 414 of them are for the purpose of controlling or regulating private and personal affairs or business. Of these 414 laws, seven provide for agricultural experiments; two protect bottlers of beer by establishing a peculiar procedure, and inflicting peculiar penalties on persons who steal bottles or unlawfully have them in their possession; fourteen regulate the sale of butter and milk; one directs how cows shall not be fed; eight are designed to protect children by regulating their employment and education; two to encourage organizations of workmen; one establishes standard packages for cranberries; one provides for the construction of proper waste-gates in dams; four are in aid of deaf-mutes; three regulate the manufacture and sale of fertilizers; two offer bounties for the production of jute, flax, and hemp; fifty-seven are for the protection of game and fish; thirty-six are for the protection of health; two deal with the cutting and sale of ice; twenty-seven regulate the business of insurance; ten establish and encourage a bureau of labor statistics; seven aim to improve meadow and swamp lands; three deal with pilots and their apprentices; six incorporate rifle societies, and encourage marksmanship; seventy-seven concern education; twelve provide for the maintenance of an industrial school for girls; four are for the better securing of wages to workmen; and six concern the relief, protection, etc., of workmen.

This exhibit of Mr. Lewis's exemplifies excellently the tenor of legislation in New Jersey. We could wish that we had as accurate an analysis of the laws elsewhere; but it will be seen that there is general consensus of opinion among our correspondents to the effect that the tendency toward State interference is not confined to any one State or group of States.

Prof. E. J. James of Philadelphia writes that "the course of legislation in Pennsylvania is very similar to that in Minnesota;" and Professor Holmes of the University of Virginia mentions local option, railroad supervision, the multiplicity and inquisitorial character of the taxes, civil marriages, and the drummers' tax law (recently declared unconstitutional) as recent evidences of a similar development of legislative activity.

Our most definite reply from the south-western States comes from Hon. Logan H. Roots, president of the board of trustees of St. John's College, Little Rock, Ark. Mr. Roots says that "a tendency upon the part of the indolent to ascribe their poverty to honesty, and the prosperity of the industrious to dishonesty, seems to have seized the ignorant; and the legislators pandering to that tendency have many of them acted on the theory that any thing or person that prospered was *per se* a 'fraud' which must be regulated. The special 'frauds to be regulated' in the eyes of our recent Legislature were money-lenders, telephones, railroads, and cottonseed-oil mills, with some attention given to prices at which merchants might transact business."

Of the central-western States, Ohio, Indiana, and Illinois are following the same road that we find to be so popular elsewhere. Ohio has a board of stock commissioners with absolute power to regulate the trade in live-stock and all importations, dairy commissioners, and special laws to govern the sale of farm-products, laws prohibiting the sale of liquor in certain places, and so on through a long list.

Illinois is overrun with such laws, and Mr. Edward J. Cahill of Chicago sends us a long list of them. Since 1871, Illinois has been in the grain-weighing business: it designates elevators for the storage of grain, and regulates its transportation by railroad. Mills and millers are carefully looked after, including the manner of grinding, the character of the buildings and tools used, etc. A bounty of ten dollars an acre is at the disposal of those who will plant forest-trees. Fence-laws appoint fence-viewers, who see that all fences are four and a half feet high, and that proper materials are used. A State board of agriculture, with a corps of salaried officials, promotes agriculture and horticulture. This board spent thirty-six thousand dollars in 1885, and is authorized to bestow five thousand dollars annually in premiums at fairs and stock-shows. The Bureau of Statistics, organized in 1879, has become a department of state, and presents annual reports on the social, educational, and sanitary condition of the laboring-classes. Game-laws are numerous. The manufacture of butter and cheese is regulated: five hundred dollars goes every year to assist dairymen in making reports. Illinois offered ten thousand dollars to the citizens who had exhibits at the New Orleans exhibition; it also pays from fifty thousand to one hundred thousand dollars to assist cities which, through the negligence of their officials, fail to take proper precautions against damage and loss by fire and water. Mr. Cahill also points out what the effect of the passage of such bills has been on subsequent Legislatures. In the session of 1887, for instance, about eight hundred bills were presented to the Legislature, and fully three-fourths of them had a tendency toward State interference. "We have bills seeking to regulate contracts between employer and employee, providing for the giving to each party a given number of days' notice to quit or intention to quit, calling for mutual co-operative associations for pecuniary profit, to increase the power of the department of labor, to provide for arbitration of labor-troubles, to grant additional labor-liens, to enforce the eight-hour movement, and to encourage mutual loan associations on the co-operative plan. The effect of State interference with professions and other business interests has created new demands: the architect petitions for a special board; the stenographer demands recognition; and in due course we shall have the merchant-tailor and the corner grocer, for already we have the liquor interest asking for a State board to pass on 'good whiskey'; and the prohibitionist asks for a bureau for the study of the nature and effect of alcoholic beverages, etc.; while the 'mugwump' of religion is on hand, seeking recognition by way of 'ethical instruction' in our public schools; and, to crown the ridiculous, we have the Live-Stock Board, just created, asking 'that companies be formed for the detection and apprehension of horse-thieves;' thus making a farce of our criminal procedure."

Prof. Henry C. Adams writes that in Michigan the tendency is in harmony with that observed by Dr. Shaw in Minnesota.

President Pickard of Iowa State University finds the most striking feature in the recent legislation of Iowa to be the number of legalizing acts passed. He says that twenty-five per cent of all acts passed were designed to correct carelessness or ignorance of officers and municipal corporations; but Prof. Jesse Macy of Iowa College says that Iowa is side by side with Minnesota, and cites in evidence a number of acts passed at the last session of the Legislature. The Legislature passed laws strengthening the prohibitory liquor legislation, it made elaborate statutes regulating the practice of pharmacy and medicine, it looked after the miners' interests through a commission, it provided an arbitration board for the settlement of labor-difficulties, it laid new duties on the board of health concerning canned goods and inflammable oils, and passed a large number of laws of the same general tenor.

Ex.-Pres. A. L. Chapin of Beloit College, Wisconsin, thinks that State interference has not gone so far in that State as in Minnesota, though it is plainly seen in numerous enactments.

Mr. Frank R. Morrissey of the Omaha *Herald* represents Nebraska in our correspondence, and finds a marked tendency to sumptuary legislation in his State.

From the Pacific coast we hear of this tendency, though in California the new State constitution seems to have repressed it to a great extent. Mr. A. H. Agard of Oakland writes that proposed legislation in California manifests the tendency in question; but little progress is made, because the Legislature is restrained by the provisions of the State constitution, which forbids the enactment of laws termed 'special.' The effort on the part of the Legislature is to frame laws of such a character that they will operate restrictively, and yet not be declared unconstitutional by the Supreme Court. It might be termed 'forbidden legislation by adroit evasion.' The particular manifestations of interference just now are against the Chinese, against 'monopolies,' hydraulic mining, and the retail liquor-trade.

It will thus be seen, from this brief summary of the evidence we have gathered, that State interference has a tendency in general throughout the United States. It is more extreme in some States than others; and our analysis of the laws of Massachusetts, New Jersey, and Illinois, shows it to be particularly progressive in those States. It remains to present the various opinions entertained toward State interference by our representative correspondents.

[To be continued.]

THE NEW ROUTE FROM ENGLAND TO EASTERN ASIA, AND THE HUDSON BAY ROUTE.

A FEW weeks ago the first steamer coming from Yokohama arrived at Vancouver. Thus the new line from England to eastern Asia by way of the Canadian Pacific Railroad has been opened. In order to show the merits of this route as compared to the American Pacific railroads, we have drawn up the accompanying sketch-map. We have chosen the gnomonic projection, as it is the best means to show the shortest route between two points. The earth's surface is projected from the centre of the globe upon a tangential plain touching it in latitude 60° north and longitude 120° west. In this projection all great circles, i.e., the shortest lines between two points, are represented by straight lines. The map extends from England in the east to Yokohama in the west. It makes it clear why the North-west and North-east Passages were so eagerly sought for. They are the nearest to the great circle between England and China, which runs right through the Polar Basin. The nearer a route approaches this great circle, the shorter it is. Therefore it will be seen that the distance from London to Yokohama, *via* the Canadian Pacific Railroad, would be by far the shortest. There are several facts, however, which detract from the value of this route. We have drawn out the great circle between London and New York. It will be seen that it crosses Newfoundland. Yet ships do not keep close to the southern point of that island, on account of the numerous dangers obstructing their passage, but prefer to go a round-about way, keeping far south. The same difficulty is encountered in approaching Halifax; and therefore the longer route to New York is by far to be preferred to the shorter one to Nova

Scotia, particularly in the latter part of the winter and in spring, when ice is met with in the Atlantic Ocean. The Gulf of St. Lawrence is not navigable during part of the year on account of the heavy masses of ice. Thus the shortness of the route from England to Nova Scotia is more than counterbalanced by the dangers of navigation.

But even from New York the Canada route to Japan is far shorter than that by way of San Francisco. The difference in length between the great circle San Francisco-Yokohama and Vancouver-Yokohama may be seen on the sketch-map. It must be considered, however, that the latter cannot be made use of, as it crosses Alaska and the Aleutian Islands. Steamers must keep farther south, and must strike the San Francisco route near the longitude of the west point of Alaska Peninsula. This makes the distance from Vancouver to Yokohama somewhat longer than it would be without this chain of islands intervening. The distance from New York to Puget Sound by way of the Northern Pacific Railroad is longer than by the Canadian Road, as Lake Michigan extends so far south; but when the road from Umatilla Junction to Tacoma is finished, the difference in the two distances will not be very great. The sea-route from Tacoma to Yokohama is of course essentially the same as that from Vancouver. The great circle between these places and the ports of China runs nearly through the Tsugaru Strait, passing Hakodadi.

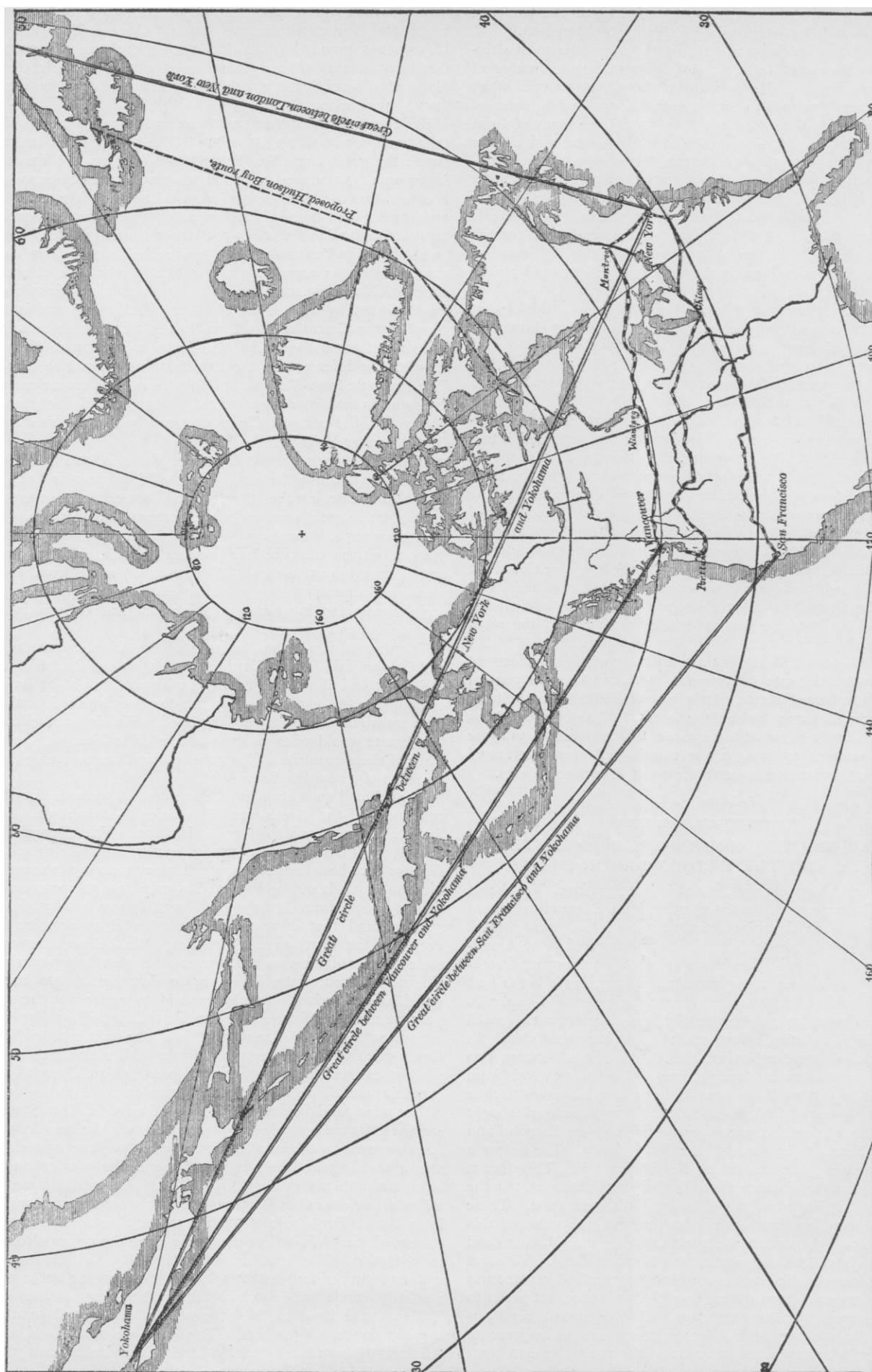
When the work on the Canadian Road is completed, it will probably be not more frequently obstructed by snow-drifts than the Northern Pacific, but the difference in distance between these two lines is not so great as to exclude a successful competition.

The harbor of Vancouver is Burrard Inlet. It is sheltered from the sea, but the entrance is somewhat difficult, being very narrow and occupied by tide-races. The shortest route from the port would lead through the narrow channels between Vancouver Island and the mainland, in which navigation is difficult on account of the strong tides and numerous rocks.

The shortest route from the ports of the Atlantic coast to Japan and China would lie even farther north than the Canadian Pacific Railroad; and if the Saskatchewan branch should be built, and continued to the northern part of the coast of British Columbia, the distance would be still more diminished. We do not believe that the climate would offer insurmountable difficulties, but the settlement of these countries will not be so rapid as to justify the construction of a new Pacific railroad.

The railroad question is of the greatest importance for the development of the North-west Territories, — Athabasca, Alberta, Saskatchewan, Assiniboia, and Manitoba. The distance to the nearest ports is so long that export is very difficult: therefore endeavors have been made to open a new route by making use of Hudson Bay. It will be seen on our map that the proposed Hudson Bay route from Liverpool to Port Nelson is very short and straight, and that it would offer a splendid opportunity for the export of the North-west Territories. We believe, however, that the character of the seas will prevent the plan being carried out. The railroad-route from Winnipeg to Port Nelson has been surveyed, and no serious obstacles are said to exist; but the railroad must be continued farther north to Fort Churchill, as Port Nelson is not a safe harbor. The navigation of the west coast of Hudson Bay, particularly for large vessels, is very difficult on account of its shallowness, and the construction of piers in Fort Churchill will be expensive and difficult on account of the ice.

The principal difficulty is the navigation of Hudson Strait. Its eastern entrance is blocked by pack-ice until the middle of July. A passage may sometimes be forced early in June by a ship well strengthened against the pressure of the ice, but navigation cannot be opened until about the 10th of July. About this time, ice is still whirling around in Ungava Bay, patches are found near Charles Island, and Fox Basin is filled with very heavy and dangerous masses of ice. We believe that these form the principal obstacles to navigation. The light ice of Hudson Bay and Hudson Strait will not form serious obstacles late in the season; but a spell of northerly winds will invariably drive the heavy masses of Fox Basin into the Strait, and a ship caught in this ice will be in an extremely dangerous position. The floes are small, and attain a thickness of from twenty to thirty feet. This ice frequently blocks



SKETCH-MAP SHOWING SHORTEST ROUTES FROM THE UNITED STATES TO EASTERN ASIA.

(This map is so projected that a straight line shows the shortest distance between two points.)

up the passages between the islands at the western entrance of Hudson Strait, where it is kept in rapid motion by strong currents. Log-books kept by whalers show that it is frequently found in Hudson Strait in September. We should say that the passage will never be safe, and that large freight-steamers, such as would be required for this trade, cannot be run longer than from the middle of July to the first days of October. It is improbable that under such circumstances a railroad to Fort Churchill and a line to Hudson Bay would pay. The shortness of the season and the dangers of the ice are so great, that this line cannot attain a great commercial value.

THINKING IN SHAPE AND PICTORIAL TEACHING.

THE Rev. Edward Thring of Uppingham, the well-known author of 'Theory and Practice of Teaching,' spoke before the teachers' guild in London recently on thinking in shape and pictorial teaching. Mr. Thring began by drawing attention to the vital distinction which divides mankind, consciously or unconsciously, into two classes,—those who value knowledge, and those who value the seeing heart and the seeing eye. The pursuit of knowledge is the creed of the first. Knowledge he defined to be for the multitude second-hand information, which, however valuable, may, like gold in the desert, be utterly useless. He then showed, that, precious or not, few get it, and that the unsuccessful attempt to get it is deadly to living power. Living power is required, and can only be given by teaching pupils to think in shape; that is, to train the mind, whenever it sees any thing, to find out at once what thought made the shape it sees; and, on the other hand, to take every word used and put it at once into some definite shape, example, or reality. Examples of this were given, showing the difference between an arithmetical fact and living feeling, between words and memory and a vivid mental picture. Then the lecturer proceeded to show that every word not vividly understood is a cipher, and that words are not vividly known, and never can be vividly known, unless thinking in shape is taught and practised. After showing the failure of memory-work, the lecturer pointed out that the commonest objects cannot be described correctly, because no one has been taught to see what they really are. A common chair can be made to give a history of thought and life and experience taking shape, and to lead up to the great fact that every shape is such a history, a living narrative, and the whole world a great illuminated volume of thought, speaking through shape which can be read by those who have learned to read thought in shape. But if this is so, then all shape is a language speaking truth or falsehood, giving honor or dishonor. And it does matter whether rooms and appliances are worthy or unworthy. How, then, has England treated lessons? Let the class-rooms in all their meanness answer. Then what class-rooms ought to be was shown, and examples brought forward of pictorial teaching. The way in which walls can be decorated without the painter going near the wall was explained, and designs for wall-decoration given. The treatment of books, and what is needed for books, next claimed attention. Then the effect on language of thinking in shape was dealt with, and the true progress of art by expression ever becoming more vivid in word and painting.

"Thinking in shape and pictorial teaching at once turn all created things into new language for thought. Every created thing becomes, on the spot, a possible new bit of thought, a possible new word born into the world of speech. I throw out, as a suggestion for any master of language, as distinct from a doctorer of words, to examine into the curious fact, that in the last eighty years the English language has in this way doubled itself, by flashing new light into old words, by new combinations of words, by freer use of allusions and metaphors, and by pictorial handling of its material; and that it is practically a new language, in its wonderful increase in power of expression, and the breathing of new life into its shape. For expression goes on forever, as higher life produces higher manifestation of life, feelings, and thought, in human face and form, and again becomes able, by being higher, more sensitive, more sympathizing, not only to see and interpret the new shapes, but to find endless riches of unknown stores of precious discoveries in the old. This is the only true path of progress.

"The pictorial mind first pictures to itself all its own ideas, and

thinks in shape; and, secondly, is ever extracting ideas, new and old, out of the things it sees, picturing to itself all the words it uses, translating and retranslating thought into shape and shape into thought, till all things live and move for it in a universe that is living thought incarnate. The lesson-book is always before it. In city or desert, church or hovel, street or field, with flower, or tree, or cloud, or sun, or animal, or bird, or insect, from end to end of all things, there is the everlasting voice crying, 'He that hath ears to hear let him hear, he that hath eyes to see let him see, for life infinite, language universal, lies at your feet for pleasure and use always.' The pictorial mind is the only power man has that is capable of infinite progress. It is the only power that belongs to all men. It is the only power that is within reach of the poor. It can be taught. It can almost be created.

"As the world goes on and knowledge increases, it will be more and more impossible to know it all, a thing which was once quite within reach. Every man, however learned, will be narrowed by degrees down to a single subject. But subjects are many. There are a thousand languages, for instance; to know how to speak even half a dozen really well is an achievement; and so on, through the whole range of knowledge. How can any one man cope with this accumulation of facts? Boasts of knowledge, therefore, belong to the nursery level, betokening stupendous ignorance of man's capacity for knowing, and of what there is to know. Let us get out of the nursery and betake ourselves to true progress, and men as they are."

But "as long as examinations reign, there can be no true teaching," said Mr. Thring, "and thinking in shape and pictorial teaching find no place."

MENTAL SCIENCE.

Can the Mind attend to Two Things at Once?

THIS question has been frequently asked, and variously answered, according to the conception of 'attention' and of the objects to be attended to. Those who lay stress on the unity of mind regard it as almost evident *a priori*, that but one concept can occupy the focus of attention at a time, and that, if apparently many are entertained by consciousness at the same moment, it is simply because of the rapidity with which the attention can flit from one to the other. The holders of the opposite view call attention to the fact that in the quickest possible glance, in the flash of an electric spark, we get a view of an object, capable of being analyzed into a series of concepts, and that we saw every one of these as well as any other. A French psychologist, M. Paulhan, has recently stated the problem in its proper aspect, and illustrated the position he takes by some very interesting experiments. What is at one time the sole object of attention, completely filling the field of consciousness, may at another be only a small part of that field. Attention, like the lens of the eye, is now accommodated to act as an instrument of near focus, high magnification, but limited aperture, and again as one of distant focus, small magnifying-power, but wide range. At one time we see the rider and the horse as a single object; at another they are two. Admitting, then, that the object of attention is determined by a subjective element, by interest, by importance, by attractiveness, or what not, it remains to similarly determine the meaning of 'attention.' Just as memory is, from one point of view, not a single faculty, but a co-ordinated set of separate, individual memories, so attention is capable of various degrees of intensity, of various subdivisions of function. There are currents and undercurrents of attention. The eye may be intently engaged in looking for a friend, while the ear is drinking in the notes of a symphony, and we are suddenly conscious of a draught in the room. Whether or not there is a loss of energy between these occupations is to be determined by experiment.

M. Paulhan wrote the lines of one poem while reciting the words of another. The two series would sometimes get confused, a word, syllable, or prominent letter of the recited verse creeping into the written; but such mistakes soon became rare. The two series are largely strung on separate strings, and proceed in parallel directions. To repeat one poem aloud, and mentally go over the words of another, caused greater confusion.

If we compare the sum of the times necessary to perform each act separately with the time necessary to perform the two together,

we arrive at the law that the simpler the operations (especially in widely disparate senses), the more time is gained in performing them simultaneously, there being a loss of time in doing complex acts at the same moment.

To multiply on paper 7,897,654,987,896,687,786 by 7 took M. Paulhan 62 seconds; to recite 25 lines of 12 feet each, 38 seconds; the sum of which is 100 seconds. To do both together required 98 seconds, so that this is about the complexity at which there is neither gain nor loss. Here is a simpler pair of processes: to write out the product of 1,321,242,131,221,241,211 by 2 required but 11 seconds; to recite a certain couplet, 7 seconds; to do both at once, only 12 seconds, — a saving of 6 seconds in 18. The maximum of saving occurs when it takes no longer to do two acts than one; then certainly the two are done at once. This occurred when 421,312,217 was multiplied by 2 while 4 lines of 12 feet each were spoken; each of the processes consuming 6 seconds separately, and no more when performed together.

If the two processes are closely similar, and probably calling into action intimately connected brain-centres, there is a more decided loss. To write out the product of 33,213,442,124,343 by 2 with the left hand while the right does the same for 12,321,443,432,123 by 2, showed a loss of 15 seconds in 38. The right did the multiplication almost twice as rapidly as the left hand.

The following times illustrate the same principle: to write four verses of 'Alholic' required 22 seconds; to recite eleven verses from de Musset required 31 seconds; to do both at once, only 40 seconds.

The sum of the times necessary to read a selection aloud and to mentally repeat another selection was 33 seconds, while to do both simultaneously required as much as 38 seconds.

An attempt was made to have three series of mental operations go on side by side; to have the left hand writing the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, while the right wrote a verse, and the vocal apparatus recited some lines of poetry. This is a very difficult matter: the two hands tended to work intermittently, and there was much evident hesitation, friction, and loss of time.

We see, then, that the brain-centres, though closely co-ordinated, can so thoroughly acquire the habit of doing their more simple functions that it requires but a small portion of the attention to guide their action, while the rest can be given to the activities of another centre. The more unlike in function the other centre, the better can this subdivision take place. But when the act is complex, it soon requires the total amount of attention at command; and to attempt to do any thing else is a loss of energy. That individuals differ largely in their powers to perform such 'double acts' goes almost without saying.

ARTICULATED AND SIGN LANGUAGE. — When we wonder at the rapidity with which deaf-mutes spell out their words on their fingers, we are apt to feel that this invention has really diminished the disadvantages of this class of persons almost to a minimum. That such is not the case is vividly suggested by the statistics which a teacher of the deaf-mute has had the patience to gather. He has counted the average number of words which a pupil in his school wrote or spelled on the fingers per day, and finds it to be 1,118: the teacher similarly employs 216, but uses signs equivalent to 861 words daily. It has been estimated that a mother talks 27,000 words to her child in a day. Making due allowance for the habit of forming only parts of sentences which the deaf-mutes cultivate, and also for the suggestiveness of the sign-language (which hearing people really also use in the form of an expressional accompaniment), the comparative meagreness of the deaf-mute's conversation, and slowness with which his mental food can be brought to him, are plainly evident.

BOOK-REVIEWS.

The Ruling Principle of Method applied to Education. By ANTONIO ROSMINI SERBATI. Tr. by Mrs. WILLIAM GREY. Boston, Heath. 8°.

OUR English educational literature has had no richer contribution than this translation of Rosmini by Mrs. Grey. It is at once philosophical, scientific, and practical. Rosmini himself is too little

known in this country; and it was our intention, in noticing this book, to give some slight idea of his life and thought in so far as they moulded educational doctrine. But in this we have been anticipated by Mr. H. C. Bowen, late principal of Finsbury Training-College. As Mr. Bowen's sketch is inaccessible to American readers, we feel that we are doing them a service in reproducing most of it. Mr. Bowen calls Rosmini 'the Italian Froebel.'

Antonio Rosmini Serbati was born at Rovereto, in the Italian Tyrol, in 1797. He died at Stresa in 1855. When it is added that he keenly felt and took an active part in the events of his time, these dates above will suffice to show us that his life is worthy of attention, and was not without its trials and exciting episodes.

It was towards the close of 1839 that Rosmini, who had already more than once published the results of his study of psychology, undertook his work on pedagogy. It appears that a pious and generous lady of Stresa, Anna Maria Bolongaro, had offered to intrust to the Institute of the Brethren of Charity (the order founded by Rosmini) the management of an elementary school which her grandfather had founded in that place. The offer was accepted, and Rosmini set to work to compose a complete treatise on pedagogy. 'The Ruling Principle of Method applied to Education' is that part of it which he accomplished, and it carries us very nearly to the end of the kindergarten age. To quote from Francesco Paoli's preface to the original edition, "Rosmini based his treatise directly upon anthropology and psychology, which give us the knowledge of the human faculties which we are to educate, and their modes of action; on ideology and ethics, which point out the objects, both proximate and ideal, by which the human faculties must be stimulated in order to be properly educated; and on ontology and theology, which provide the knowledge of the ends towards which the human faculties should harmoniously develop, to find in them rest and full satisfaction, which is the ultimate goal of human education." Rosmini divides life, not into periods of years, but into stages or degrees of cognition, — the successive acts of the understanding (*intellezioni*) through which the human mind advances in the development of its powers. The first period extends up to the first smile (roughly, a period of about six weeks), and possesses no definite cognitions, except the primary and fundamental cognition or intuition of being (the innate assurance that something is). It possesses also what Rosmini calls the 'fundamental feeling,' or that generally diffused feeling of our own bodies which, though it is not as yet attended to, constitutes us sentient beings. The cognitions of the second period, which extends up to the first articulate word (roughly, till the end of the first year), consist of the simple perception of things as subsisting, with corresponding volitions, termed by Rosmini 'affective' or 'instinctive,' which have these things for their object. Speech is the sign that the child has entered upon the third period of life, or the second order of cognitions, this order being formed by the child's analyzing the cognitions of the first order, and by his abstracting the more interesting, sensible qualities of things from the ideas of these things in his mind (imaginal ideas); and to these correspond the affective volitions, which have for their object these more interesting qualities abstracted from the actual things, and marked off from the things' other qualities, to which the appetitive faculty is at present indifferent. The third order of cognitions shows itself when the child begins to learn to read, say, at the end of the third year. We have now the exercise of the judging faculty, which has become able to connect by synthesis the elements of the previous analysis, and to affirm the existence in a subject of the qualities before abstracted. The corresponding volitions are the estimative or prizing volitions, by which the mind recognizes in a thing its interesting qualities, and thus estimates them. This is soon followed by the cognitions of the fourth order, which introduce analysis once more, as far as is necessary for forming comparisons between two objects judged of, and giving the preference to one over the other. The volitions belonging to this order are the appreciative, or the volitions of choice. The moral sense, which existed in germ in the preceding periods, now takes a larger development. The cognitions of the fifth order consist in a synthesis by which are determined the relations existing between two things combined into one, and conceived as one, of which conceptions the most important is that of the 'I' and of self-identity. About this

time appears the first dawn of conscience. And so, with their regularly alternating analysis and synthesis, Rosmini would have gone on sketching for us the characteristics of the succeeding orders. But here, to our misfortune, the treatise terminates, and we have nothing but rough notes and hints as to what would have followed. We must not, however, forget the warning which Rosmini gives us, more than once, concerning his stages of cognition. He only gives us the order in which they commence; but, when once commenced, they go on through all the other periods, increasing in power and widening in application. Moreover, the acts of the understanding are always excited by some stimulus external to themselves, and depend on this stimulus; and hence, when particular stimuli come late, we shall find the corresponding cognitions belonging to earlier orders coming into being alongside of cognitions belonging to the later orders.

But what of the practical application of all this? some of our readers may ask. Well, Rosmini himself answers, "I am a thinker, a psychologist. You good people of practice and experience must make the practical application of my principles for yourselves." But being human, as well as a psychologist, he cannot altogether refrain: he gives us some of his own 'practical applications;' and of these, some are very striking and suggestive, and some of—well, very moderate utility. "The object of instruction," Rosmini tells us, "is to bring the young to know, and it may therefore be called the art of properly directing the attention of the youthful mind." "There are always three distinct parts of instruction," he tells us elsewhere: "(a) that which serves to increase in the mind of the pupil the number of cognitions he has gained in the preceding order, and to make them more perfect; (b) that which enables the pupil to pass from the order of cognition in which he is, to the next higher order; and (c) that which serves to exercise and perfect the pupil in the knowledge belonging to the order he has just reached." He adds that it is evident that the language and style of the teacher should vary according to the order of cognition attained by the child. All language that goes beyond that order is wasted; or, worse still, it will produce confusion. In treating of the first order of cognition, he points out that nature has placed perception as the foundation of the whole immense pyramid of human knowledge, and that perception therefore should be the foundation of all human education. "Nature herself leads the child to observe every thing, and to experiment on every thing; but all these experiments and perceptions are unconnected and desultory. The earliest office of the educator, therefore, consists in regulating the child's observations and experiments, so as to lead him to perceive and to perfect his perceptions." The application of this is little more than hinted at, but enough is given to show how strikingly alike Rosmini and Froebel were with regard to the earliest childhood, though each worked independently and in complete ignorance of the views of the other. Indeed, one of the chief advantages of studying Rosmini's system is the added strength and clearness and meaning which it so frequently gives to the plans of Froebel, who, as a practical teacher, stands a head and shoulders taller than his Italian contemporary. Nor is Rosmini's psychology always equal to Froebel's. He has, for instance, some strange views on language, which, but for Prof. Max Müller's championship of very similar ones, would come upon us not only as novel, but also as startling. Rosmini holds that "by language we form our ideas," and that "man could not have invented that part of language which expresses abstractions." But, what is far more disconcerting to a teacher, is to find him stating that "one of the fundamental principles which should govern the instruction given, from first to last, is to consider language as the universal instrument provided by nature for the intellectual development of man," and to see, in the application, that this means that education is to be mainly a training in the use of words. Still, undoubtedly many of the practical hints he gives for the teaching of reading and writing will be found valuable, though they are applied somewhat prematurely; and much that he says on the use of music, and on picture-teaching, is highly suggestive. On the whole, however, we are inclined to think that teachers will be most struck with, and set most value on, the exposition given of the gradual development of the moral sentiment,—"based as upon a rock, on the great fact, that, rooted in the depths of the child's nature, there is a primary

necessity of growing respect and love to whatsoever intelligent being he comes to know,"—and with this, step by step, the corresponding gradual training. We have met with nothing elsewhere so soundly reasoned, so clearly expressed, and so practically suggestive; though here, again, the general line pursued is the same as that pursued by Froebel.

For the present we will say no more. But we hope we have said enough to prove to teachers that 'The Ruling Principle of Method' is a book to be studied with pleasure and profit. And, though some of us may be inclined to pronounce the system as rather logical than psychological, we shall all of us gain by coming in contact with a mind so eminently clear and reasonable, and so full of human kindness.

T. Macchi Plauti Captivi. With Introduction and Notes. By W. M. LINDSAY, M.A. Oxford, Clarendon Pr. 16°.

Anglice Reddenda; or, Extracts for Unseen Translation. (Second Series.) Selected by C. S. JERRAM, M.A. Oxford, Clarendon Pr. 16°.

FROM the Clarendon Press comes a very neat little edition of the 'Captivi' of Plautus, by Mr. W. M. Lindsay, intended as a companion to the 'Trinnummus' of Messrs. Freeman & Sloman of the Westminster School, where the plays of Plautus have been frequently exhibited by the scholars with much dramatic and archæological success. The only fault to be found with those exhibitions, however, is their practice of ignoring the musical element, that must undoubtedly have been an important feature in the original production of the Plautine plays. In fact, the ancient divisions of the comedies were effected solely by the musical passages, or 'Cantica;' and in the manuscript the name of the musical performer at the first exhibition of the play is often given in the title, or, rather, after it. In the present edition of the 'Captivi,' Mr. Lindsay has very properly called attention to this fact, which even careful students of the Roman drama are too apt to overlook; and his remarks, although unduly brief, will be instructive to the young student, for whom this little book is intended. Within the limits which the editor has marked for himself in the preface, he has done very excellent work, availing himself of the most recent German research, and giving notes, that, while useful to the school-boy, are often very suggestive to the more mature scholar. Mr. Lindsay properly regards the Plautus lecture as affording "the best opportunity for teaching the etymology and structure of Latin words," and he has therefore given this side of the subject particular attention in the notes. The book may be unreservedly commended as being precisely what it professes to be,—an edition of the 'Captivi' that will "enable boys of the higher forms to read with intelligence and interest a play which, more than any other of Plautus, may suitably be put into a school-boy's hands."

The reading of Greek and Latin at school is deservedly becoming an important part of the preparatory training for college, both in England and our own country. The advantages of an ability to read an ordinary classical author without the aid of a dictionary are so obvious as to need no comment, and, as they impress themselves more and more upon our instructors, a much-needed reform will gradually come about. One may hope to see the day when college-examinations will test not only the memory, but the genuine knowledge, of the student, and when the object will be to discover not merely how much he knows of some particular author, or portion of an author, but of the language as a whole. Already sight-reading of easy Greek and Latin has become a part of the required entrance-examinations at Yale and Harvard, it has for some time held a prominent place in the classical instruction at Columbia, and the time is not far distant when it will form one of the important tests of all our leading colleges. Mr. C. S. Jerram of Trinity College, Oxford, already well known as the author of several useful publications, has just sent forth a volume of extracts for sight-reading, bearing the imprint of the Clarendon Press, and entitled 'Anglice Reddenda.' It supplements a much simpler work issued some years ago, and is intended for students who may reasonably be supposed to have acquired a somewhat extensive vocabulary. The extracts are about equally divided between Greek and Roman authors, and are admirably selected so as to interest and entertain as well as to instruct. It may be doubted, however, whether such excerpts as odes from

the first book of Horace, fragments of the fourth Æneid, passages from the *Metamorphoses* and *Fasti* of Ovid, and the first eclogue of Vergil, will possess the requisite novelty to the class of students for whom this book is professedly intended.

Common Sense Science. By GRANT ALLEN. Boston, Lothrop, 12°.

Studies in Life and Sense. By ANDREW WILSON. London.

IF the question, 'What is the ideal method of popularizing science?' were raised at any of our large scientific meetings, about as many minds as men would probably be heard. Everybody admits the importance of the topic; everybody recognizes that science is all along getting popularized and gradually rendered digestible by the average man: but there is much difference as to the relative value of the several agencies by which this result is being produced, and the direction which these efforts should take in the future. There is a great deal of false popular science, — a class of writing in which the difficult points are always skipped, and the light and temporarily interesting ones unduly magnified; in which the interest is attracted towards certain minor points, and the whole doctrine set forth in a perverted perspective. One can dress up the facts of science in as attractive a garb as one likes; but the aim must be to bring home the fact, and not the study of the costume. The spirit of accuracy by which science is differentiated from uncritical knowing is the *sine qua non* of a real interest in scientific work.

Into what category of 'popular-science' writing one will put this work of Grant Allen's will depend largely on one's conception of the purposes of such literature. The geniality and attractiveness of his style are well known. They are important factors in the success of his works. The present series of essays exhibit the strength and the weakness of this class of writing. Its strength consists in its power to bring home simple truths in a way that suggests their real significance to the average mind; its weakness, in the fact that so much of it is not 'common-sense' science, but 'common-place' science: it says very little for the amount of words.

A striking feature of this and other recent general works is the great rôle which psychological subjects are now playing in science. Of the twenty-eight essays here printed, ten are distinctly psychological, and many others partly so. The main reason of this increased interest in the scientific study of mental phenomena is the recognition of their intimate relation with education. We are beginning to appreciate that the requisite for rationally educating the mind is to accurately know it.

It is only just to Mr. Allen to give a sample of some of the essays. A very typical one is that on self-consciousness, the tone of which will be readily gathered from the following sentences: "A philanthropist who had it in his power to abolish, if he chose, with a single wave of his hand, either small-pox or self-consciousness, would probably do more in the end to diminish human suffering and to increase human happiness if he elected to get rid, by an heroic choice, of the less obtrusive but more insidious and all-pervading disease; for small-pox, at the worst, attacks only a very insignificant fraction of the whole community; while every second person that one meets in society, especially below the age of fifty years, is a confirmed sufferer from the pangs of self-consciousness." The essay on memory sets forth in apt illustrations the complexity of human knowledge; that on the balance of nature, the inter-relation between the various classes of organic life. Under the title 'Big and Little,' is a lesson on the relativity of knowledge. The 'Origin of Bowing' traces the gradual refinement of a savage's slavish obeisance into the modern gentlemanly courtesy. 'The Pride of Ignorance' teaches an admirable lesson, as also does the essay on home-life. Other sufficiently suggestive titles are 'Holly and Mistletoe,' 'Sleep,' 'Amusements,' 'Evening Flowers,' 'Genius and Talent,' and so on.

Like all his works, this collection of papers will doubtless find a large and appreciative public. To those who do not already know the facts which it contains, it will offer an attractive method of acquiring them.

The spirit of Dr. Wilson's book is quite a different one. There are many who will listen to Mr. Allen who would not listen to Dr. Wilson; but those who choose the latter will not be sorry for their

choice. There is in these essays an unusual amount of information, well and attractively put together. It needs to be read attentively, but leaves the reader with the same feeling of satisfaction that one experiences when rising from a good and substantial meal. There will follow a process of healthy digestion, and the food will contribute some little to the making of its partaker.

Dr. Wilson is a biologist, and the sixteen careful studies contained in this volume touch portions of the entire field, from the 'Inner Life of Plants' and 'The Past and Present of the Cuttlefishes,' to the 'Body and Mind.' In each topic the author writes as one perfectly at home; avoiding the fault of attempting to tell too much, as well as of having too little to tell. It is popular-science writing, a very good type indeed.

Like the former book, this, too, is characterized by a preponderance of psychological subjects. Seven of the essays treat entirely or mainly of mental phenomena, while several others touch upon such topics. 'The Old Phrenology and the New' is an unnecessarily painstaking refutation of the claims of the 'cranial-bump examiners,' with a brief account of the evidence for the modern doctrine of the localization of function in the cortex of the brain. The old phrenology serves as an excellent type of the shoals, on which the hasty wanderer, leaving the straight but slow path of scientific advance, is likely to be wrecked. The nature of the relation between nerve-tissue and mental phenomena is outlined in the paper on body and mind; the main point being to show by striking examples the strange effects produced by intense expectation and concentration, which furnishes the kernel of truth in the claims of the mind-cure. 'The Mind's Mirror' explains the development of the expression of the emotions in animals and men, while 'The Coinages of the Brain' is a timely account of the part played by hallucinations in such happenings as our psychic-research societies are likely to record.

The more strictly biological essays treat of the economies of nature, showing, that, as conditions vary, nature utilizes every trifle, and avoids waste, or scatters tons of pollen over a barren soil. There are two excellent chapters on the zoölogical position of monkeys and elephants; while the volume closes with 'An Invitation to Dinner,' which gives occasion to a lesson on the physiology of digestion.

In the present case the proverbially odious comparison can hardly be avoided. Dr. Wilson's is in every way the better book; but Mr. Allen's will have the wider public, and, it is to be hoped, will incite an appetite that will lead to the searching for the more substantial food.

NOTES AND NEWS.

THE American committee of the International Congress of Geologists — a committee appointed by the American Association — will present a report at the meeting of the American Association in August concerning the positions to be taken by the representatives of American geologists at the next session of the congress in London (1888), upon the more important questions of nomenclature, classification, and coloring, which will there be discussed. It requests that Section E set apart a day for the purpose of considering these questions to be submitted by the committee, and of aiding that body to ascertain the direction of American opinion thereon. In order the better to accomplish this object, it requests Section E to issue an invitation to all American geologists (whether members of the American Association or not) to attend this session and participate in the work. The American committee also request that members of the association be informed of the opportunity offered for obtaining the great geological map of Europe, now preparing by a special committee of the International Congress. This map will be issued in 49 sheets, which, combined, will cover a space about 11 by 12 feet. The price is \$20 a copy, with additional charges of duty and expenses amounting to about \$6. Incorporated scientific institutions are of course exempt from duty-charges. For further information address Dr. Persifor Frazer, secretary of the American Committee, 201 South Fifth Street, Philadelphia, Penn.

— The Entomological Club of the American Association will meet on the day prior to the meeting of the association, at 2 P.M. The

Brooklyn Entomological Society has appointed a committee to welcome the members of the club, and to assist in making the meetings interesting, as well as to give such information regarding matters of special interest to entomologists as may be desired. The same society will arrange for one or more field-excursions in the vicinity of New York, and a reception will be arranged for. Members of the club intending to contribute papers will please communicate the same to the president, Prof. J. H. Comstock, Ithaca, N.Y., or to the secretary, Mr. E. Baynes Reed, London, Ontario.

— The Botanical Club of the American Association will hold its meetings, as usual, during the week of the association. For particulars address Mrs. E. L. Britton, secretary of the club, Columbia College, New York.

— The Society for the Promotion of Agricultural Science will hold its eighth annual meeting in New York, beginning on Monday evening, Aug. 8, at Columbia College, and continuing on Tuesday. For further information address Prof. W. R. Lazenby, secretary, Ohio State University, Columbus, O.

— The aggregate production of shad for distribution the present season by the United States Fish Commission has been enormous. The number produced has been increasing from season to season, owing to the perfection of the methods in use. A summary of the distribution for the present season, arranged by river-basins, is as follows:—

Penobscot River.....	1,169,000
Kennebec River.....	800,000
Tributaries of Narragansett Bay.....	1,275,000
Hudson River and tributaries.....	1,979,000
Tributaries of Delaware Bay.....	5,099,000
Tributaries of Chesapeake Bay.....	68,149,000
Tributaries of Albemarle Sound.....	5,322,000
Tributaries of South Atlantic coast.....	3,566,000
Tributaries of Gulf of Mexico.....	7,048,000
Inland waters.....	1,014,000
Total.....	95,421,000

It will thus be seen that over 68,000,000 young shad-fry have been returned to the waters of Chesapeake Bay. The entire production of the fisheries of the Chesapeake for the present season was about 2,000,000 young shad. It is therefore evident, that, for every mature shad taken from the waters of the Chesapeake, thirty-four young, healthy, and vigorous shad have been returned to those waters. Experiments already made by the commission indicate, that, up to the close of their river-life (the young shad migrating in October), twenty per cent of the fry placed in our rivers will survive, and attain a size of from two to three inches in length. Arrangements have been made by the commission to secure complete statistics of the shad-catch all along the entire coast for the present year, similar statistics having already been collected in 1885 and 1886. Information already in the hands of the commissioner makes it certain that the aggregate production of shad on the coast has been larger the present season than at any time in the last twenty years, but it will be impossible to give the measure of increase. For the Potomac River it is already assured that the increase of 1887 is fully 100,000 shad over that of 1886, and the increase of 1886 over that of 1885 exceeded 100,000. In the Potomac fisheries alone in the last two seasons the increase in shad has been over 250,000; the increase representing a much larger number than the entire catch of 1879, in which year the fisheries of the Potomac reached their lowest ebb.

— Professor Riley, the entomologist of the Department of Agriculture, has made public the result of an exhaustive personal investigation into the habits of the *Phorodon humili*, or hop-louse. His discoveries are expected to prove of great value to hop-growers, as he has succeeded in learning the habitation of this plant-pest during the winter months, and tracing it through the varying stages of insect-life. Before the investigation, it was not known how or where the insect survived the winter. As a result of his inquiries, Professor Riley has satisfied himself that the eggs laid by the female at the close of the summer are deposited in plum-trees, where the insect hatches in the spring, and resides until the third generation. This third brood, unlike its predecessors, is winged, and immediately after development abandons the plum-tree and attacks

the hop-vine. In the autumn a counter-migration from the hop-vine to the plum-tree occurs, the winter eggs are deposited, and the cycle of life goes on in the same way. It is a notable fact that in regions where the cultivation of hop-vines is a new industry, the growers have had complete immunity for a while from the pest. In California to-day they are not troubled by it. Professor Riley believes that the *Phorodon humili* has been brought to this country from Europe on plum-stock; and there is reason to believe that the *Phylloxera*, the dreaded grape-pest, was carried from this country to Europe on grape-vine cuttings. Therefore California hop-growers are warned to beware of importing plum-stock from eastern hop-regions. These discoveries render it possible to check the ravages of the hop-louse either by the use of insecticides in the springtime, before the insect has reached the winged state, or by the destruction of the sheltering plum-trees. The experiments will be continued with a view to protecting the hop-vines after they have become infected with the hop-louse.

— The project of holding a summer school of physics at Harvard College this season has been abandoned; but on July 19 and 20 apparatus designed for use in the 'forty-experiment course,' preparatory for admission to Harvard College, will be shown to teachers or others at the Jefferson Physical Laboratory, and questions relating to the experiments will be answered. The same thing will be done for the 'sixty-experiment course' on the second day, July 20.

LETTERS TO THE EDITOR.

. The attention of scientific men is called to the advantages of the correspondence columns of SCIENCE for placing promptly on record brief preliminary notices of their investigations. Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

The editor will be glad to publish any queries consonant with the character of the journal.

Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

Theoretical Meteorology.

A REVIEW of Professor Ferrel's recent work on this subject in *Science* for June 3 furnishes an opportunity to present a few points on this subject. Professor Laughton, ex-president of the Royal Meteorological Society, once said that there was hardly a theory in meteorology that was well established. If this be so, it seems to me there is great danger of putting too much reliance upon mere theory, which does not have a sufficient groundwork of facts. There is special danger of this in meteorology, where the mathematical discussions of gaseous movements and vortices are hedged about with so much difficulty and complication. I am well aware that the views here advanced are opposed to those of many most advanced thinkers in this field, and I only ask an unbiassed hearing.

To my mind there are at least two fundamental errors in this subject, but these are intimately interwoven throughout its warp and woof. These are, first, that there is friction only between the air and the earth, or at least that friction between contiguous air strata may be neglected; second, that conditions and changes of pressure, temperature, and moisture in the atmosphere, are the only causes acting in producing either its general motions or storms.

The objections to the first theory are briefly as follows. At a height of 100 feet, or at the most 200 feet, in a level country, there is no longer friction between the air and earth, but rather between air and air. This is especially the case on the ocean; and here, surely, we would have no waves, if it were not for the friction between air and air. If there were no friction, all storms would take place in a virtual vacuum, and into a vacuum air would tend to flow with about the velocity of sound. Professor Ferrel thinks, that, according to laws of gaseous motion, the earth's atmosphere would leave the poles and heap itself at the equator, but this is prevented by friction with the earth's surface; but, as we have just seen, we need consider only friction of air on air at 100 feet elevation.

The objections to the second theory cannot be set forth as easily as the above. When we are gravely told that the sun heats up a certain portion of the earth's surface, and that in consequence vertical currents are set up which finally bring about a wind of 100 miles an hour, we can but be credulous. As a matter

of fact, the sun does not heat up a limited portion of the earth. Its rays shine with equal intensity over 1,000 miles from east to west. It has also been shown that this heating of the surface does not ascend more than a few inches in the air. One of the strongholds of the theorists is unstable equilibrium; but right here we find two seemingly contradictory statements. On p. 51 of Professor Ferrel's book, 'Recent Advances in Meteorology,' there is a suggestion that this state (unstable equilibrium) is brought about whenever there is a less diminution of temperature with height in an ascending column than in neighboring portions of air. On p. 328 of the same volume, however, the idea is given that this same state may be produced if there is an abnormally great diminution of temperature with height. It would seem as if in both these instances, even if there were a tendency to this state, air would flow in at all times from surrounding regions, and instantly relieve the condition. This relief would be afforded the more rapidly, the less the friction. However, the error here is farther back. We cannot suppose that the atmosphere is either quiescent or flowing in a current having a uniform velocity in all its layers, to the height, say, of 15,000 feet. The fact is admitted that there is a uniform acceleration in the different strata as we arise; so that, even if an upward movement should begin, a few hundred feet would destroy all vertical tendency. As a matter of fact, when we consider the actual conditions under which solar radiation acts at a storm-centre, we see that this unstable state could not be formed. At a storm-centre clouds cover the earth's surface, and prevent all abnormal conditions from great heat. Balloon-ascents have shown uniform temperatures up to the top of the clouds.

The theoretical computations of the velocity of the upper air strata do not correspond with the actual movements recorded. On p. 259 Professor Ferrel gives the velocity of the current at the height of 16,000 feet as 26 miles per hour in the middle latitudes of the United States.

On Mount Washington, 6,300 feet in height, the velocity when a low area passes is 53 miles per hour, and when a high area passes it is 21. The velocity of the low areas near Mount Washington is 34 miles per hour. This would indicate that the 'power' of the storm must be below 6,300 feet, since it is admitted that its progressive motion is due to the movement of the strata where it exists. It may be safely said that a height of less than 6,000 feet for the centre of disturbance would be fatal to a great many of the present theories of storm-generation.

Formerly it was said, that, owing to friction with the earth's surface, the upper part of the storm must be in advance of the lower; but it is certain that such a state of things could continue only a few minutes, for the upper portion of the storm would be rapidly separated from the lower. Professor Ferrel, on p. 260 of the present volume, explains this difficulty by suggesting that the upper part of the storm is continually re-forming itself, and that there is no actual transference of air. I hardly think that this suggestion will be accepted. It seems to me our storms would behave differently if it were true, and certainly our synoptic charts do not give any clew to such re-formations of the upper part of the storm. It seems to me this later theory destroys the continuity of the ascending current and the essential features of unstable equilibrium. One of the most difficult phenomena to explain is the fall of rain at a distance of 300 and more miles from the storm-centre. If we suppose the ascending currents are at the centre of the storm, then rain should fall at that point. Professor Ferrel, at p. 266, advances the novel idea that the rain is formed in or carried to the upper currents, and, as these are more rapid than the storm, it must fall in advance of the storm. I do not think this theory takes sufficient account of the facts. Let us suppose the raindrop carried to a height of 7,200 feet; observations in balloons show that rain very rarely occurs above that height, and that the 'power' of the storm is at 5,000 feet. We may consider the velocity of the current at 7,200 feet 15 miles per hour greater than at 5,000 feet: the drop would fall at about 10 feet per second, or would reach the earth in 12 minutes; and hence, if it had been carried in the upper current during this time, it would have fallen 3 miles in front of the centre, instead of 300 or more. As a matter of fact, since the currents below 5,000 feet are very much slower than above that height, any acceleration would be entirely overcome, and from these principles the drop

would actually fall back of the centre. On the continent of Europe the bulk of the rain falls at the rear of the storm.

To my mind, however, theoretical meteorology most signally fails in its attempts to explain our more violent storms and tornadoes. That the sun's heat could start a vertical current which, with the condensation of moisture in the upper air, would give rise to winds of 200 or 300 miles per hour, seems incredible. The attempt to meet the difficulties by suggesting 'great contrasts of temperature,' 'meeting of warm southerly with cold northerly winds,' 'cool air overrunning warm,' 'warm air overrunning cool,' etc., does not seem at all satisfactory. As long as it was supposed that tornadoes occurred at the centre of a low area where it was thought there was an ascending current, the theory seemed plausible; but when it was clearly shown, in March, 1884, that tornadoes do not occur at a low centre, but 400 or 500 miles to the south-east, it became necessary to explain this. It seems to me that all attempts to elucidate this subject have merely served to lighten the darkness without removing it.

There is no space left for minutely examining the great superstructure built on what seem weak foundations. It seems as though the first and most important step is to remove the slur cast upon this science by those who are qualified to know its weakness. Let our theorists bend every energy to establish some fundamental proposition, either by actual experiment in the laboratory or by investigation in nature's laboratory at the spot where the 'power' of the storm manifests itself. It seems to me the recent attempts of Weyher in France to demonstrate the existence of this 'power,' by means of a rapidly revolving fan at some distance above water or grain, show the great need of further proof. These experiments show what might be if only there were an enormous fan in the upper air, but where is the fan? Must we not conclude that the true explanation is now farther off than before, and certainly much farther from the present theories.

H. ALLEN HAZEN.

Washington, July 1.

Determination of the Depth of Earthquakes.

THE report of Captain Dutton and Everett Hayden on the Charleston earthquake (*Science*, ix. p. 489) is undoubtedly a very valuable addition to earthquake literature. There are two or three points, however, to which I wish to draw scientific attention, in the hope that investigation hereafter may clear them up.

Perhaps the most interesting and important point in the report is their method of determining the depth of earthquakes. The authors first review rapidly other methods. Mallet's method — by protracting the lines of emergence back to their meeting-point — they dismiss as too uncertain. Seebach's method — used in the earthquake of Central Germany in 1872, which depends on the law of decreasing velocity of the emergent wave — they also dismiss, because the times of arrival at different points cannot be determined with sufficient accuracy, on account of the different velocities of the two different kinds of waves, normal and transverse. In place of these methods they propose what they claim to be a wholly new one, founded on the law of decrease of intensity; i.e., of decrease of the shock-motion or motion of the earth-particle, or, in other words, the wave-height or amplitude.¹ They show by mathematical discussion that the place of the maximum rate of decrease of intensity bears a fixed relation to the depth of the focus; viz., as 1 to $\sqrt{3}$. Upon this basis they estimate the depth of the focus to be about twelve miles. In Fig. 1, which we reproduce from their report, the fall of the double-curved line represents the decreasing intensity. The place of most rapid fall, i.e., where the curve changes from convexity to concavity, is the place of most rapid decrease of intensity. This place was quite distinctly marked. It was about seven miles from the epicentrum.

We wish now to draw attention to the fact that this method does not differ very greatly from, and perhaps is not an improvement upon, another method suggested by Mallet in his 'Report to the British Association, 1858,' p. 102, though not used in his discussion of the Neapolitan earthquake of 1857; viz., by means of what may be called 'the circle of principal disturbance.' This method is mentioned and explained in my 'Elements of Geology,' p. 117. The authors seem to have overlooked it.

¹ With constant wave-length, intensity $\propto$ amplitude.

The destruction about the epicentrum of an earthquake depends mainly, perhaps, upon the amount of motion, but partly also upon the direction of motion; horizontal motion being far more destructive than vertical. Now, the whole amount of motion is assumed to decrease as the square of the radius of the agitated sphere increases ($d \propto \frac{1}{r^2}$); but the horizontal element of the motion increases as the cosine of the angle of emergence. Under these two conditions, there will be a certain distance all about the epicentrum, bearing a fixed relation to the depth of the focus, where the horizontal element will be a maximum. This is at dd' (Fig. 2), where the angle of emergence is $54^\circ 44'$. In other words, the 'circle of principal disturbance' is the base of a cone whose apex is at the focus, and whose apical angle is $70^\circ 32'$. The distance ad of this circle from the epicentrum is to the depth of focus ax as 1 to $\sqrt{2}$.

Now, it is evident that in violent earthquakes the destruction over the whole area of this circle might be nearly the same; for in the central parts the whole motion would be greater, and on the margins the sideways motion would be greater. But beyond this circle the destructiveness would very rapidly decrease, because the whole motion and the sideways element are both decreasing: in other words, if we used the graphic method, the curve of destructiveness would be like the curve of intensity (Fig. 1), except

pose the spherical wave were cut off, not on one side only, but on both sides; in other words, suppose a shock generating normal circular elastic waves of compression to occur in the centre of a thin plate: is it not evident that the intensity of these would vary simply inversely as the radius ($I \propto \frac{1}{r}$)? Or, if the plane be reduced to a bar, such waves would be substantially constant in intensity.

But we are not left to general reasonings on the subject. If the intensity or wave-height follow the law of inverse squares, it is impossible to understand how the waves should carry so far as we actually find. In the Charleston earthquake the motion at the distance of six hundred miles was still sufficient to create alarm and to produce seasickness. Now, the amount of motion at the epicentrum was not more than ten or twelve inches. Let us take twelve inches as the greatest motion, and the epicentrum as ten miles from the focus. At the distance of six hundred miles, according to the usually assumed law of decrease, the amount of motion or wave-height would be only a three-hundredth of an inch; but if the spherical wave is reflected back from the surface, and combines with the advancing wave, it is probable that its decrease is only as the increase of the radius. In that case, at six hundred miles the motion would still be a fifth of an inch, which is a very sensible motion.

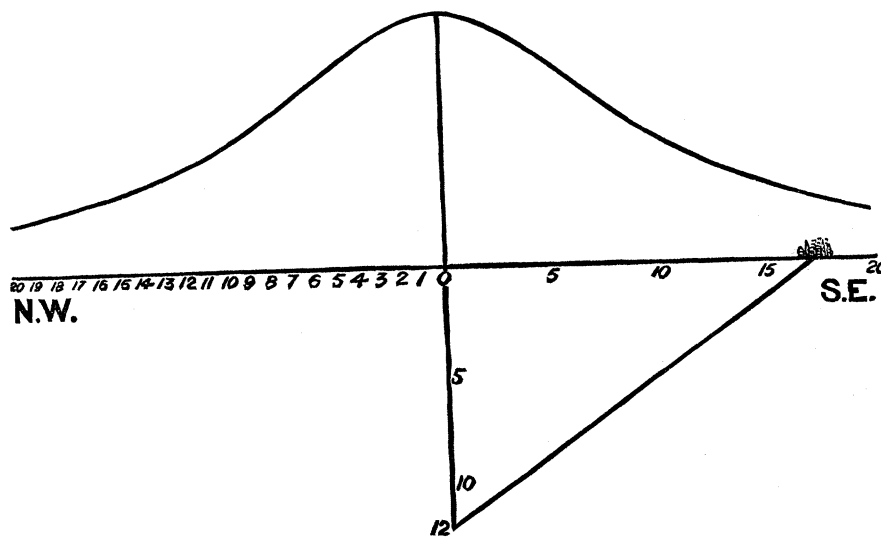


FIG. 1.

that it would be flatter on the top, and the descent more abrupt at a certain distance from the epicentrum. The decrease of destructiveness is more rapid at a certain point than is the decrease of intensity.

Now, since the intensity is estimated largely, if not wholly, by destructiveness, and since destructiveness depends largely upon the sideways motion, is it not possible, is it not even probable, that the supposed place of maximum decrease of intensity is really the place of maximum decrease of destructiveness; i.e., the circle of principal disturbance? If so, then the depth of the focus would be about ten miles instead of twelve miles.

We have assumed all along that the intensity or excursion of the earth-particle, or the height or amplitude of the wave, varies inversely as the square of the radius of the agitated sphere ($I \propto \frac{1}{r^2}$). The authors as well as all other writers assume this law. But is there not good reason to doubt its accuracy? The law is probably true so long as the wave is spherical; i.e., until it emerges on the surface. But when it emerges, what becomes of the energy which would have continued the wave if it had not been cut off by emergence? Some of it is doubtless consumed in more violent motion, and perhaps rupture, at the surface; but is not much of it reflected back into the earth to combine with the advancing waves? All other elastic waves, whether light-waves or sound-waves, coming out of a denser medium into a rarer (or *vice versa*), are largely reflected from the surface: why not earthquake-waves also? Sup-

pose the spherical wave were cut off, not on one side only, but on both sides; in other words, suppose a shock generating normal circular elastic waves of compression to occur in the centre of a thin plate: is it not evident that the intensity of these would vary simply inversely as the radius ($I \propto \frac{1}{r}$)? Or, if the plane be reduced to a bar, such waves would be substantially constant in intensity.

While on this subject, it may be well to say something about Seebach's method of determining the depth of the focus. The method by the circle of principal disturbance, and that by maximum decrease of intensity, are based on the law of inverse squares, and

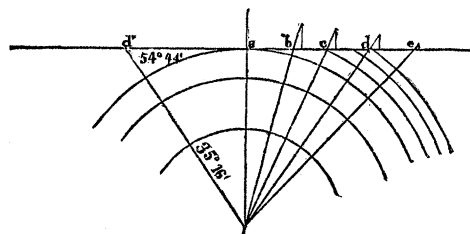


FIG. 2.

therefore fail if this law be untrue. Seebach's method, on the contrary, is based on the law of decrease of velocity of the surface wave; supposing, of course, a constant velocity of the spherical wave. I have been in the habit of representing Seebach's method as follows: on the co-ordinate axes A, B, C, D (cd being the earth surface), of the earth, let equal times be taken on AB , and spaces passed over in equal times on CD . The one represents the

constant velocity of the spherical wave, and the other the decreasing velocity of the surface or emergent wave. By connecting these points by rectangular co-ordinates, an equilateral hyperbola is developed, the centre of which is the focus x , and the character of which depends on the depth of the focus. The hyperbola becomes more and more triangular in form as the depth becomes less (as in taking the surface at $c'd'$, $c''d''$), until, if the focus is at the surface, the hyperbola becomes a right-angled triangle; i.e., the surface wave passes over equal spaces in equal times. If, therefore, we plot accurately the times on AB , and the corresponding places on CD , we may develop the hyperbola and calculate its centre; or else by accurate trial we may find a point which shall be the centre of circles passing through corresponding times and places. That point will be the focus. Such is a very general account of the method, given in my own way. For more accurate detail, Seebach's work must be consulted.

We believe that this method, in a thickly settled country dotted over with observatories on railroad-stations where accurate time is kept, will prove the most accurate. Dutton and Hayden object to this method that it is important to have the accurate time of arrival

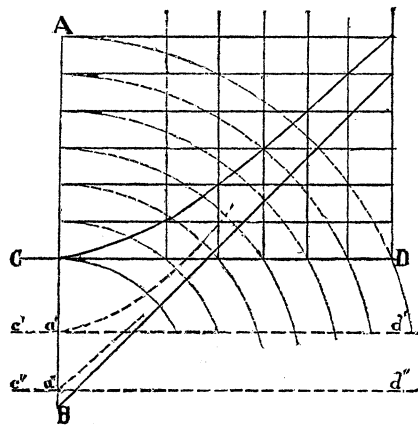


FIG. 3.

of the wave, because there are two kinds of waves, — the normal and transverse, — which run with different velocities. The answer to this is, that it is only over a comparatively small area that, on any method, observation can be relied on for estimating depth. Inspection of Fig. 3 shows that the arm of the hyperbola very soon becomes almost straight; the velocity of emergence at any considerable distance becomes sensibly the same as that of the spherical wave, and therefore can no longer indicate depth. But over the small area where the curve of the hyperbola, or change of velocity, is rapid, the time of arrival of the different waves would not greatly differ. At any rate, the use of seismographs which decompose the complex earth-motions will record these different waves separately, and thus enable us to determine the law of decrease of one of them — the normal — with accuracy.

In conclusion we would insist that we cannot any longer afford to study earthquakes without seismographs. The Geological Survey ought to have these in different parts of the country. The University of California has recently gotten three of these of the best character (Ewing's and Gray-Milne's), which will soon be set up in different parts of the State.

JOSEPH LECONTE.

Berkeley, Cal., June 21.

The Corresponding Volumes, etc., of Ice and Sea-Water.

THESE determinations were made in Hudson Strait (latitude $62^{\circ} 33' 45''$ north, longitude $70^{\circ} 41' 15''$ west), in an inlet having a width of a little more than half a mile. I am thus particular in giving the width, because in a very narrow tidal harbor, with the ice fast on either shore, the line of flotation of the ice would sensibly alter with a rising or falling tide. In this instance I was particular in watching for such a difference, under these opposite conditions; but, if present, it was insensible.

The determination was made on Feb. 3, 1885, when the temperature of the air was -3° F.; for the water, $26^{\circ}.7$ F.

A hole having been cut through the ice, of such a size as to pre-

vent any sensible error owing to capillarity, its thickness was found to be 2 feet 9.6 inches from surface to surface; on top of the ice was an estimated average depth of snow of 3 inches, of such a density that by weight it was equal to 1.1 inches of the ice: the total thickness of ice, or its equivalent, would therefore be 2 feet 10.7 inches. Of this amount, 32.5 inches were submerged; leaving, therefore, 2.2 inches of ice, or its equivalent, above the water-line.

Therefore sea-water-ice floats with one part above the water-line and fourteen and eight-tenths below. Expressing the volume of a given quantity of sea-water by unity, its volume, when converted into ice, would be 1.0634; and their densities as 0.922 to 1.000.

W. A. ASHE.

The Observatory, Quebec, June 24.

Death of W. O. Ayres, M.D.

THE death of Dr. W. O. Ayres, one of the early members of the California Academy of Sciences, has recently been made known.

He was specially interested in the study of ichthyology, and for many years after his arrival in California, in the intervals of an extensive medical practice, contributed to this department of natural history by his investigations of and publications upon the fishes of California. At the first meeting of the academy of which there is any published record, Sept. 4, 1854, he presented descriptions of two new species, *Labrus pulcher* and *Hemitripterus marmoratus*, which still stand, though the generic status has been modified, — now *Harpe pulchra* and *Scorænichthys marmoratus*. His contributions to the ichthyological knowledge of the Pacific coast were frequent for many years, especially from 1854, as above, to the year 1863. His scientific inquiries sometimes extended, though rarely, towards other forms of animal life. He returned to his native State, Connecticut, about 1872 or 1873. His services to the cause of science on the Pacific coast in those early days entitle him to grateful remembrance.

R. E. C. S.

U. S. Nat. Mus., June 28.

Cause of Consumption.

THE experimental together with the clinical study of tuberculosis has established the view that there are three factors in its causation:—

First, The presence of the parasite, the tubercle-bacillus, as a pathogenic element. This factor is necessary for the production of the disease.

Second, Heredity figures as a prominent element in about thirty per cent of the cases ordinarily met with.

Third, Mal-hygienic and debilitating agents, such as foul air, sedentary occupations, violations of the laws of health, and diseases, have a powerful effect, by impairing the nutrition, in developing the disease.

Heredity and lowered vitality cannot of themselves produce tuberculosis, but clinically they play an important rôle as factors by rendering the individual more vulnerable to bacillary influence.

FRANK DONALDSON, M.D.

Baltimore, Md., June 29.

Volapük.

YOUR correspondent, 'H. T. P.,' in your issue of the 24th of June, asks for information about Volapük. I can refer him to a most interesting article upon this subject, which appeared in the *Bulletins de la Société d'Anthropologie de Paris*, 1885, pp. 317–321. The article is by M. Kerckhoffs, who has published the following work, 'Cours Complet de Volapük,' par A. Kerckhoffs (Paris, 1886), and contains a sketch of the structure of the language and some interesting information about its prospects, progress, etc.

A. F. CHAMBERLAIN.

Toronto, June 28.

Queries.

7. DEATHS AND THE TIDE. — A physician living near the sea states that during the past five years he has noted the hour and minute of death in ninety-three patients, and every one has gone out with the tide, save four who died suddenly by accident. Is there any other evidence to sustain this statement? — D.